

# **ULTRASONIC DETECTOR INSTALLABLE ON A TRUCK TRAILER**

## **BACKGROUND OF THE INVENTION**

### **1. Field of the Invention**

The present invention is related to an ultrasonic detector installable on a truck trailer, and more particularly to an ultrasonic detection apparatus that can be easily installed on the rear section of the truck trailer, ingeniously adapting an existing power source of the vehicle to power the transceivers of the ultrasonic detection apparatus.

### **2. Description of Related Art**

Most passenger vehicles on the road are now equipped with electronic backing-up detectors, but large vehicles still rely on the conventional rear view and wing mirrors to check road conditions behind the vehicles. These large vehicles are not that easy to maneuver like passenger vehicles because of the extended length and bulkiness of the vehicle body, so these vehicles have a more pressing need to use electronic detectors that may provide extra guidance in parking and backing up. However, one of the problems in installing electronic backing-up detectors on special purpose vehicles such as truck trailers is how to power the backing-up detectors when a power source is not readily available on the rear section of the truck trailer. Conventionally, backing-up detectors draw electricity from the backing-up light of the vehicle, but the truck trailer does not have backing-up tail lights on the rear section.

One alternative is to use a storage battery in the backing-up detector configuration. Although the backing-up detector can obtain a power source

1 using this method, the battery only provides limited operation time. Following  
2 this line of thinking, there are other problems, such as how to check the battery  
3 status and how to relate the battery status to the driver. The backing-up detector  
4 will stop functioning after the battery is depleted, but the driver would not  
5 know that the backing-up detector is out of service simply because of a battery  
6 problem.

7 Special design efforts need to be made if a storage battery is to be used  
8 to provide necessary power for the backing-up detector if it is to be used on a  
9 truck trailer.

#### 10 SUMMARY OF THE INVENTION

11 The main object of the present invention is to provide an ultrasonic  
12 detector that can be easily installed on the rear section of special vehicles such  
13 as truck trailers, which comes with a special connector to adapt an existing  
14 power source used by the vehicle to power the transceiver operation.

15 To this end, the configuration of the ultrasonic detector comprises:  
16 a console unit being installed in the driver compartment of the truck trailer;  
17 and  
18 multiple ultrasonic detection units being installed on the rear section.

19 Each ultrasonic detection unit has multiple transceivers and a controller  
20 chip. The transceivers are used to emit ultrasonic waves, receive reflected wave  
21 signals, and convert the reflected signals to pulse signals for further processing  
22 by the controller chip.

23 Pulse signals from all ultrasonic detection units will eventually converge  
24 on the console unit, where the pulse signals are processed by the

1    microprocessor to calculate the closest distance between the object and the  
2    vehicle body, and to determine if the object is within a preset warning range, so  
3    as to issue a warning to the driver. No matter whether the object is at a safe  
4    distance or not, the microprocessor regularly forwards the distance information  
5    to a digital display.

6            The data communications between multiple ultrasonic detection units and  
7    the console unit can be implemented either through an RF interface or a cable  
8    interface, both of which are built into the control circuitry of the detector.

9            The ultrasonic detection unit is formed by a controller chip, multiple  
10   transceivers, a storage battery and a recharge circuit, wherein the storage  
11   battery is coupled to the night light of the vehicle, so that the recharge circuit  
12   draws electricity from the night light of the truck trailer to recharge the storage  
13   battery, which used to provide the operating voltage to all components in the  
14   ultrasonic detection unit.

15           The ultrasonic detection unit is controlled by the brake light of the truck  
16   trailer. Whenever the brake light is enabled, the transceivers of the ultrasonic  
17   detection units will be switched to the active state to emit ultrasonic signals,  
18   receive reflected signals, and generate pulse signals. It shall be noted that all the  
19   above processes are to be completed in one operation cycle. When the brake  
20   light is disabled, the ultrasonic detection unit will be switched to the standby  
21   state, whereby the transceivers are disabled; and if the night light is enabled,  
22   only the storage battery will be recharged during the non-braking period.

23           The cable interface is responsible for data transmission between the  
24   ultrasonic detection unit and the console unit using cable media. When the

1 cable interface is used, a bidirectional communication mode is effected between  
2 the controller chip of the ultrasonic detection unit and the console unit, but the  
3 unidirectional communication mode is still used when the controller chip  
4 detects that the brake light is enabled, in which only the controller chip of the  
5 ultrasonic detection unit is allowed to transmit the distance data to the console  
6 unit.

7 The RF interface is responsible for data transmission between ultrasonic  
8 detection units and the console unit through radio frequency communication.  
9 When the RF interface is used, unidirectional communication mode is effected  
10 between the ultrasonic detection unit and the console unit, which means that  
11 only the controller chip transmits the distance data to the console unit.

12 The console unit has a microprocessor, an alarm, a digital display, and a  
13 corresponding RF interface and cable interface.

14 On receiving the pulse signals, the microprocessor converts the pulse  
15 signals to the relative distance between the object and the vehicle body. If the  
16 object is within a preset warning range, the microprocessor will activate the  
17 alarm; the distance data are regularly passed to the digital display. The driver is  
18 continuously updated with the distance information to assist in parking or  
19 moving in reverse gear.

20 Other objectives, advantages and novel features of the invention will  
21 become more apparent from the following detailed description when taken in  
22 conjunction with the accompanying drawings.

## 23 BRIEF DESCRIPTION OF THE DRAWINGS

24 Fig. 1 is a block diagram of the system architecture of the present

1 invention;

2 Fig. 2 is a schematic diagram of the components in the ultrasonic detection  
3 unit;

4 Fig. 3 is an external view of the ultrasonic detection unit; and

5 Fig. 4 is a schematic diagram of the components in the console unit.

6 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

7 The present invention is illustrated through a preferred embodiment as  
8 shown in Fig. 1, comprising a console unit (10) and one or more ultrasonic  
9 detection units (20), wherein

10 the console unit (10) is installed in the driver compartment of the truck  
11 trailer; and

12 multiple ultrasonic detection units (20) are installed on the rear section of  
13 the truck trailer.

14 The console unit (10) is linked to the ultrasonic detection units (20) either  
15 through cables or wireless means, as both units (10, 20) are equipped with a  
16 respective cable interface (15) (27) and an RF interface (14) (26) for supporting  
17 different modes of data communications.

18 One console unit (10) collects pulse signals from all the ultrasonic  
19 detection units (20), basing on which the console unit (10) calculates the closest  
20 distance from any object, and then determines whether the object is within the  
21 preset warning range, so as to initiate the alarm to warn the driver of the object  
22 behind the vehicle.

23 As shown by the schematic diagram of Fig. 2, the ultrasonic detection unit  
24 (20) is formed by multiple transceivers (21-24), a controller chip (25), a second

1 RF interface (26), a second cable interface (27), a storage battery (28) and a  
2 recharge circuit (29).

3 The ultrasonic detection unit (20), as in the present example, uses four  
4 transceivers (21-24), where the transceivers (21-24) are used to emit ultrasonic  
5 waves, receive reflected wave signals, convert the reflected wave signals to  
6 pulse signals, and eventually pass the pulse signals to the controller chip (25)  
7 for further processing.

8 The controller chip (25) is to process the pulse signals received from the  
9 transceiver (21-24) to generate the relative distance. Also, the controller chip  
10 (25) is to control the sequence of firing by all transceivers (21-24), and to check  
11 the brake light of the truck trailer which is used as control signals to initiate the  
12 firing of ultrasonic waves. When the controller chip (25) detects the brake light  
13 signal, the controller chip (25) initiates an operation cycle of the transceiver  
14 (21-24) to emit ultrasonic waves (for example 10-30 sec), and then to receive  
15 reflected waves within a predetermined interval, and then to generate pulse  
16 signals to be passed to the controller chip (25). All the above processes are to  
17 be completed within one operation cycle. Then, the controller chip (25) sends  
18 them through either the second RF interface (26) or the second cable interface  
19 (27) to the console unit. When the operation cycle of the transceivers (21-24)  
20 comes to an end, the controller chip (25) therefore switches the transceivers  
21 (21-24) to the standby state to save on power. At the same time, the controller  
22 chip (25) checks the power status of the storage battery (28), and passes that  
23 information through the second RF interface or the second cable interface (26) /  
24 (27) to the console unit (10).

1       The second cable interface (27) is responsible for data transmission  
2   between the controller chip (25) and the console unit (10) using the cable media.  
3   When the first and second cable interface (15) (27) are interconnected by a  
4   cable, the bidirectional communication mode is effected between the controller  
5   chip (25) and the console unit (10), whereby the controller chip (25) of the  
6   ultrasonic detection unit (20) transmits the distance data to the console unit (10),  
7   and the console unit (10) issues the instructions to the controller chip (25) of the  
8   ultrasonic detection unit (20). The unidirectional communication mode is still  
9   used when the controller chip (25) of the ultrasonic detection unit (20) detects  
10   the brake light signal, whereby only the controller chip (25) of the ultrasonic  
11   detection unit (20) is allowed to transmit the distance data to the console unit  
12   (10).

13       The second RF interface (26) is responsible for data transmission between  
14   the ultrasonic detection units (20) and the console unit (10) through radio  
15   frequency communication. When the first and second RF interface (14) (26) are  
16   used, unidirectional communication mode is effected between the controller  
17   chip (25) of the ultrasonic detection unit (20) and the console unit (10), which  
18   means that the controller chip (25) transmits the distance data to the console  
19   unit (10).

20       The storage battery (28) provides the operating voltage for all components  
21   in the ultrasonic detection unit (20). When the remaining power in the storage  
22   battery (28) falls below the minimum level, and the night light of the vehicle is  
23   enabled, the recharge circuit (29) is enabled to draw electricity from the night  
24   light of the vehicle to recharge the storage battery (28). This operation is not to

1 be interrupted by on/off of the brake light. As the brake light and the night light  
2 are standard equipment on the trailer, the ultrasonic detector system therefore  
3 secures a reliable power source and control signals. The brake light is enabled  
4 when the brake pedal is depressed. Then, the controller chip (25) detects the  
5 brake light signal and activates the operation cycle of the transceivers (21-24).

6 The ultrasonic detection unit (20) has a power saving mechanism that is to  
7 switch all transceivers (21-24) from the active state to the standby state when  
8 the brake light is turned off. The brake light is on only when the brake pedal is  
9 depressed, so that the braking time is quite brief in each interval and randomly  
10 scattered over a given period of time. Most of the time, the detector operation  
11 just lasts for one or two operation cycles. Therefore, on the average, the braking  
12 time is relatively short as compared with the night light illumination time.  
13 Therefore the storage battery (28) charge shall be sufficient to meet the power  
14 requirement of the ultrasonic detection unit (20), and to maintain the normal  
15 operation of the ultrasonic detection unit (20).

16 As shown in Fig. 3, the ultrasonic detection unit (20) has multiple  
17 transceivers (21-24) aligned through holes, a storage battery (28), a controller  
18 chip (25) and a control circuitry consisting of a second RF interface (26), a  
19 second cable interface (27), and a recharge circuit (29), all embedded in the  
20 casing. The second cable interface (27) of the ultrasonic detection unit (20) is  
21 connected to a power source through a special connector (201). When the  
22 ultrasonic detection unit (20) uses the cable transmission, the special connector  
23 (201) is connected to the second cable interface (27) of the ultrasonic detection  
24 unit (20) leading to a communication cable, and the special connector (201) is



1 also coupled to the brake light and the night light. When the ultrasonic  
2 detection unit (20) uses the second RF interface (26), the special connector (201)  
3 is connected to the brake light and the night light, eliminating the use of the  
4 second cable interface (27).

5 The casing of the ultrasonic detection unit (20) is mounted on the rear  
6 section of the vehicle body by screws or other fastening means.

7 As shown in Fig. 4, the console unit (10) is formed by a microprocessor  
8 (11), an alarm (12), a digital display (13), a first RF interface (14) and a first  
9 cable interface (15).

10 The microprocessor (11) collects the pulses from all outlying ultrasonic  
11 detection units (20) through the first RF interface/first cable interface (14) / (15),  
12 and then processes the pulses to generate the closest distance between the  
13 object and the vehicle body. The microprocessor (11) also obtains the power  
14 data from all ultrasonic detection units (20) to determine whether the remaining  
15 power in the storage battery (28) of each ultrasonic detection unit (20) is  
16 sufficient to maintain normal operation. If the remaining power is found to be  
17 below the minimum level, the microprocessor (11) issues a warning through the  
18 digital display (13).

19 The digital display (13) is used to present the relative distance between the  
20 object and the vehicle body. The digital display can be a seven-segment LED or  
21 LCD display. The digital display (13) receives the relative distance data from  
22 the microprocessor (11) and presents the distance information to the driver.

23 The alarm (12) can be a buzzer. Under the control of the microprocessor  
24 (11), the alarm (12) emits beeping sounds with different frequencies to reflect

1 the closeness of the object to the vehicle body. The frequency and the pitch will  
2 increase as the vehicle approaches the object; and likewise the frequency and  
3 pitch will decrease when the distance between the vehicle and the object  
4 increases. The alarm (12) will stop when the object is beyond the preset  
5 warning range.

6 The first RF interface (14) is responsible for the data transmission between  
7 the microprocessor (11) and the ultrasonic detection unit (20) through radio  
8 frequency communication. When the RF interface (14) is used, the  
9 unidirectional communication mode is effected between the console unit (10)  
10 and the ultrasonic detection unit (20), that is, the channel is only open for the  
11 ultrasonic detection unit (20) to transmit the distance data and the battery data  
12 to the console unit (10).

13 The first cable interface (15) is responsible for data transmission between  
14 the microprocessor (11) and the ultrasonic detection unit (20) through cable  
15 media. When the first cable interface (15) is used, the bidirectional  
16 communication mode is effected between the console unit (10) and the  
17 ultrasonic detection unit (20), that is, the console unit (10) receives the distance  
18 data from the ultrasonic detection unit (20), and at the same time, the console  
19 unit (10) issues instructions to the ultrasonic detection unit (20); but it could  
20 also operate in unidirectional mode. In that case, the channel is open for the  
21 ultrasonic detection unit (20) to transmit the distance data to the console unit  
22 (10).

23 From the foregoing, the present design ingeniously uses a special  
24 connector to allow the ultrasonic detector to adapt the brake light of the vehicle

1 to obtain necessary control signals for initiating the operation of the  
2 transceivers, and the special connector is also connected to the night light to  
3 secure a reliable power source, in consideration of the fact that the truck trailers  
4 usually do not have back-up lights on the tail end. Also, the present invention  
5 provides an option to use either wireless means or cable for data transmission  
6 between outlying ultrasonic detection units and the console unit, as the  
7 necessary communications interfaces are built into the ultrasonic detector. This  
8 is a user choice, so the back-up detector can be custom made to match the  
9 actual needs.

10           It is to be understood, however, that even though numerous  
11 characteristics and advantages of the present invention have been set forth in  
12 the foregoing description, together with details of the structure and function of  
13 the invention, the disclosure is illustrative only, and changes may be made in  
14 detail, especially in matters of shape, size, and arrangement of parts within the  
15 principles of the invention to the full extent indicated by the broad general  
16 meaning of the terms in which the appended claims are expressed.